CLAIMS

We claim:

20. A component for use in a prosthetic joint, the component comprising:

a generally spherical substrate,

topographical features located on said substrate,

a diamond table sintered to said substrate in order to form a sintered polycrystalline diamond compact,

a load bearing and articulation surface on said polycrystalline diamond compact, said load bearing and articulation surface including polycrystalline diamond, said load bearing and articulation surface being formed to present a surface that accommodates joint articulation.

21. A joint component as recited in claim 20 wherein said substrate surface topographical features tend to provide a greater surface area of contact between said substrate and a diamond table than the surface area of contact would be without said topographical features.

22. A joint component as recited in claim 20 further comprising chemical bonds between said substrate and said diamond table.

23. A joint as recited in claim 20 further comprising a mechanical grip between said substrate and said diamond table.

24. A joint as recited in claim 20 further comprising a zone of composition gradient in which both diamond and substrate metal are found.

25. A joint as recited in claim 20 said topographical features are selected from the group consisting of waves, straight grooves, curved grooves, straight ridges, curved ridges, dimples, holes, protrusions, depressions, spherical segment depressions, spherical segment protrusions, hemispherical concave cups, hemispherical convex protrusions, partially spherical convex shapes, lines, curved lines, polygonal depressions, polygonal protrusions, cylindrical

depressions, cylindrical protrusions, frusto-conical depressions, frusto-conical protrusions, waffle iron patterns and waffle patterns.

26. A joint component as recited in claim 20 further comprising a first topographical feature that is a depression to a first depth and a second topographical feature that is a depression to a second depth, wherein said first depth is not equal to said second depth.

27. A joint component as recited in claim 26 wherein said second depression is located in said first depression.

28. A joint component as recited in claim 27 wherein said first and second depressions have an outer periphery shape that is selected from the group consisting of round and polygonal.

29. A joint component as recited in claim 27 further comprising a third topographical feature that is a depression to at third depth, wherein said third depth is not equal to said second depth, and said third depth is not equal to said first depth.

30. A joint component as recited in claim 29 wherein at least one of said depressions has an outer periphery shape selected from the group consisting of round and polygonal.

31. A joint component as recited in claim 30 wherein said substrate includes CoCr as a solvent-catalyst metal.

32. A joint component as recited in claim 20 said substrate includes a metal selected from the group consisting of titanium, aluminum, vanadium, molybdenum, hafnium, nitinol, cobalt, chrome, molybdenum, tungsten, cemented tungsten carbide, cemented chrome carbide, fused silicon carbide, nickel, tantalum, and stainless steel.

33. A joint component as recited in claim 20 wherein diamond in said polycrystalline diamond compact has a coefficient of thermal expansion $CTE_{Cd}$,

wherein said substrate has a coefficient of thermal expansion $CTE_{sub}$, and wherein $CTE_{Cd}$ is not equal to $CTE_{sub}$.

34. A joint component as recited in claim 20 wherein diamond in said polycrystalline diamond compact has a modulus $M_{Cd}$, wherein said substrate has a modulus $M_{sub}$, and wherein $M_{Cd}$ is not equal to $M_{sub}$.

35. A component for use in a prosthetic joint, the component comprising:

a generally spherical polycrystalline diamond compact,

a diamond table on said polycrystalline diamond compact, said diamond table including polycrystalline diamond,

a substrate located on said polycrystalline diamond compact,

an interface between said substrate and said diamond table,

chemical bonds between said substrate and said diamond table, and

a load bearing and articulation surface located on said polycrystalline diamond compact, said load bearing and articulation surface being formed at least in part by polycrystalline diamond of said diamond table, said load bearing and articulation surface being formed to present a surface that accommodates joint articulation.

36. A joint component as recited in claim 35 wherein said diamond table covers only a portion of the exterior surface of said substrate.

37. A joint component as recited in claim 36 wherein said polycrystalline diamond compact has a radius R1; wherein said substrate beneath said diamond table has a partially spherical shape; wherein said substrate partially spherical shape beneath said diamond table has a radius R2; and wherein R1 > R2.

38. A joint component as recited in claim 37 further comprising topographical features on said substrate beneath said diamond table.

39. A joint component as recited in claim 38 wherein said topographical features are selected from the group consisting of waves, straight grooves, curved grooves, straight ridges, curved ridges, dimples, holes, protrusions,

depressions, spherical segment depressions, spherical segment protrusions, hemispherical concave cups, hemispherical convex protrusions, partially spherical convex shapes, lines, curved lines, polygonal depressions, polygonal protrusions, cylindrical depressions, cylindrical protrusions, frusto-conical depressions, frusto-conical protrusions, waffle iron patterns and waffle patterns.

40. A joint component as recited in claim 35 further comprising substrate surface topographical features.

41. A joint component as recited in claim 40 wherein said substrate surface topographical features tend to provide a greater surface area of contact between said substrate and a diamond table than the surface area of contact would be without said topographical features.

43. A joint component as recited in claim 40 wherein said topographical features serve to redistribute forces applied to said polycrystalline diamond compact.

44. A joint as recited in claim 40 wherein said topographical features serve to mitigate crack formation and propogation in said polycrystalline diamond compact.

45. A joint as recited in claim 40 wherein said topographical features serve to distribute residual stress through said polycrystalline diamond compact.

46. A joint as recited in claim 40 wherein said topographical features serve to provide a strong mechanical grip between said diamond table and said substrate.

47. A joint as recited in claim 35 further comprising a neck located on said polycrystalline diamond compact, said neck protruding from the generally spherical periphery of said polycrystalline diamond compact, and the neck serving as an attachment point for the joint component.

48. A joint component as recited in claim 47 wherein said diamond table covers substantially all of the joint component except the neck.

49. A joint component as recited in claim 47 further comprising substrate topographical features.

50. A joint as recited in claim 49 wherein said topographical features are selected from the group consisting of waves, straight grooves, curved grooves, straight ridges, curved ridges, dimples, holes, protrusions, depressions, spherical segment depressions, spherical segment protrusions, hemispherical concave cups, hemispherical convex protrusions, partially spherical convex shapes, lines, curved lines, polygonal depressions, polygonal protrusions, cylindrical depressions, cylindrical protrusions, frusto-conical depressions, frusto-conical protrusions, waffle iron patterns and waffle patterns.

51. A joint as recited in claim 35 wherein at least some of said substrate surface topographical features are radiused in order to avoid generation of stress concentrations.

70. A prosthetic joint comprising:

a substrate,

a diamond layer sintered to said substrate,

interstitial spaces located in said diamond layer,

solvent-catalyst metal located in said interstitial spaces,

a zone that includes both sintered diamond and substrate, said zone having a composition gradient of solvent-catalyst metal content to diamond content, said gradient being selected from the group consisting of interface gradient, continuous gradient and incremental gradient,

chemical bonds in the component, said chemical bonds including diamond-to-diamond bonds in said diamond layer, diamond-to-metal bonds in said zone, and metal-to-metal bonds in said solvent-catalyst metal,

a mechanical grip between said diamond layer and said substrate which tends to secure said diamond layer to said substrate, and

a non-planar load bearing and articulation surface formed by said diamond layer.

71. A component as recited in claim 70 further comprising a lip of substrate material which serves to hold said diamond layer in place adjacent said substrate.

72. A component as recited in claim 70 further comprising a dovetailed interlock between said diamond table and said substrate.

73. A component as recited in claim 70 further comprising a lip on said substrate that interlocks said substrate with said diamond table.

74. A component as recited in claim 70 wherein at least some of said bonds are sp3 carbon bonds.

75. A component as recited in claim 70 wherein said diamond table includes a plurality of strata such that a first of said strata having characteristics which differ from those of a second strata.

76. A component as recited in claim 75 wherein said differing characteristics are selected from the group consisting of diamond particle size, diamond particle distribution, and solvent-catalyst metal content.

77. A component as recited in claim 70 wherein said diamond table is formed using CoCr as a solvent-catalyst metal.

78. A component as recited in claim 70 further comprising a plurality of diamond strata in said zone.

79. A component as recited in claim 70 wherein said diamond table presents a non-planar diamond load bearing and articulation surface.

80. A component as recited in claim 70 wherein said interstitial spaces are filled with a metal.

81. A component as recited in claim 70 wherein said interstitial spaces are filled with solvent-catalyst metal.

82. A component as recited in claim 70 further comprising a transition zone in said substrate.

83. A joint as recited in claim 70 wherein said substrate surface topographical features are selected from the group consisting of waves, straight grooves, curved grooves, straight ridges, curved ridges, dimples, holes, protrusions, depressions, spherical segment depressions, spherical segment protrusions, hemispherical concave cups, hemispherical convex protrusions, partially spherical convex shapes, lines, curved lines, polygonal depressions, polygonal protrusions, cylindrical depressions, cylindrical protrusions, frusto-conical depressions, frusto-conical protrusions, waffle patterns and waffle iron patterns.